advanced a step further on the road to incorporation than University College. The Royal College of Science, with its intimate connection with the Board of Education and its exceptional facilities for training teachers of science, would worthily fill an important part in the work of the University. The Central Technical College of the City Guilds, subsidised by the wealthy City companies, provides higher education, and could immediately take its place in the University to teach advanced technology. Bedford College, too, which has specialised in the direction of the higher education of women, must be included.

Finally, there are the polytechnics. On more than one occasion it has been pointed out in NATURE that the amount of research work accomplished in the polytechnics of greater London rivals successfully that done in many university colleges. It must, it is true, be admitted that to be worthy of the great University which it is hoped the current decade will see thoroughly established, the polytechnics will have to curtail their work. At present they attempt the education of all comers from twelve years of age and upwards. But just as it has been made a condition of the incorporation of University College that the school in connection with it shall be moved elsewhere, so in the case of the polytechnics, the existing day schools for boys and girls, where an education on the lines of the "School of Science" curriculum of the Board of Education is given, will have to be transplanted, in order that the buildings and the equipment of the polytechnics may be entirely at the disposal of the senate of the University. Similarly, the recreative side of the general training offered by many of the polytechnics will have to be provided elsewhere, for it will scarcely be compatible with the dignity of a great university to perpetuate the present arrangements for providing students with social enjoyments. With these modifications, and perhaps some others, the polytechnics, situated as they are in all parts of the metropolitan area, as will be seen from the accompanying outline map (Fig. 1), based upon the Report of the London Technical Education Board for 1900-1901, are peculiarly well adapted to become constituent colleges.

There are immediate advantages accruing from an arrangement such as that outlined of a comprehensive university, consisting of the three university colleges, the Royal College of Science, the City Guilds Institute, the thirteen or so polytechnics, and perhaps a few other more specialised institutions, all bound together as necessary parts of one university, possessing the same aspirations, and all engaged in the same work of higher education. Such an organised whole will effect far more for London than the present individual and sporadic efforts of separate uncoordinated institutions competing the one against the other. And such an university could still preserve its former character as an imperial examining board for granting degrees.

A development of this kind and on this scale will doubtless necessitate the expenditure of many times the million pounds asked for by University College. But when the inhabitants of the wealthiest city in the world are educated to understand that no spending is so profitable as that on higher education and on the endowment of research, there will be little difficulty in obtaining the necessary funds. The immediate necessity is the provision of the amount required to ensure the incorporation of University College in the University of London; but this must be followed by a strenuous endeavour on the part of all men of science and influential men in every other department of mental activity to instruct Londoners in their duty towards their city and country of providing a permanently endowed University of London, consisting of constituent colleges situated in every part of the enormous area for the higher education of which the University is responsible.

PROF. ALFRED CORNU.

CORNU was born in 1841 at Châteauneuf, and entered the great military school of Paris, the École Polytechnique, at the age of nineteen. After four years of study there he entered the École des Mines, which he quitted in 1866, thus completing a brilliant career as a student. One year later, at the age of twenty-six, he was chosen as professor of physics at the École Polytechnique, a post which he filled to the end of his life and adorned with the many results of his scientific researches.

It would be impossible in a brief review of Cornu's life to give more than the barest outline of his contributions to original knowledge. His position as a teacher gave him, amidst the material surroundings of his laboratory, the leisure to work. The beauty, the dignified ease and perfection of his investigations, the keen perspicacity of his observations, the masterly restraint, so to speak, of the scientific memoirs which from time to time he contributed to the scientific world, all bespeak a man of no ordinary capabilities, a master of his profession. Clear in his exposition of scientific matters, exquisitely clear alike in his experimental demonstrations and in the language in which he expounded their theory, he was as great in teaching as in research. Optics was his first love, and though he laboured successfully in other branches of experimental physics, it was to optics that he returned, and in the field of optics were achieved his greatest successes in physical investigation. The pages of the *Comptes rendus* and of the *Journal de Physique* bear eloquent testimony to the activity and penetration of his mind. Already, from 1863 to 1865, he had begun to contribute to the Académie des Sciences notes, the earliest of which relate to the refraction and reflection of light and to the problems of crystalline reflection. Following on the work of Jamin, he later pursued the subjects of vitreous and metallic reflection, and studied the connection between them. He showed that they were but parts of one and the same phenomenon, though affecting different regions of the spectrum, there being, as he showed, a true continuity between them.

Soon after entering upon the duties of his chair Cornu began with laborious and patient preparation those experiments upon the velocity of propagation of light which have become classical. Fizeau on the one hand, Foucault on the other, had already made determinations, each on his own lines. Foucault's value, then supposed to be the best, was $2{\cdot}98 \times 10^{10}$ in C.G.S. units. Cornu's results, of which an account will be found in some detail in NATURE of February 4, 1875, raised this figure to $3{\cdot}004 \times 10^{10}$, in vacuo, or $3{\cdot}0033$, in air. His method, which was fundamentally the same as that of Fizeau, was applied to the transit of light over a distance of 46 kilometres (or between two stations 23 kilometres apart, the one at the Observatoire, the other at Monthéry); and the instrumental perfection of his rotatory apparatus enabled him to observe up to the twenty-first extinction of the beam, thus securing a precision far in advance of that attained by Fizeau. For his determination of the velocity of light he was awarded the *prix Lacaze* in 1878, the same year in which his merits were recognised by his admission to the Académie des Sciences. In 1872 he wrote papers on the theory of electrostatics, in which he expounded the potential theories of Gauss and Green, then little known in France. They are to be found in vol. i. of the *Journal de Physique*, then recently founded by his friend d'Alméida.

For several subsequent years Cornu was occupied with researches on the spectrum. He measured the wave-lengths of the hydrogen rays with a precision previously unknown, enabling a comparison to be made between the values so obtained by experiment and the theoretical formulæ which had been

proposed by Balmer and others to express them. The suggestions of Dr. Johnstone Stoney and the later developments of Kayser and Runge will not be forgotten in this relation. He also made observations on atmospheric absorption in the spectrum, using photographic methods, at his country house at Courtenay, where he used to spend most of his vacations. He thus was able to fix the inferior limit to the ultra-violet end of the spectrum, so far as it is visible at low elevations, and found that in the laboratory air is opaque to ultra-violet waves of a lesser wave-length than $0{\cdot}185\ \mu$. His work on meteorological optics has thus been summarised by M. Guillaume:—"Such researches, in the course of which he was often led to a scrutiny of the sky, could not fail to draw his attention to the optical phenomena of the atmosphere, the study of which, though energetically pursued by the French physicists of last century, is to-day somewhat neglected. The splendid glows which were observed in the sky toward the end of 1883 furnished to Cornu an occasion to utilise the profound knowledge which he possessed of the phenomena of optics. He showed that the twilight glow, which at that time gave such marvellous charm to the sunsets, was due to a diffraction caused by fine powders, and it became evident that the formidable volcanic explosion of Krakatoa was the prime cause of it."

Cornu published an elegant method for the investigation of the optical constants of lens systems. He devised the optical lever for the measurement of the curvatures of lenses, and he perfected the Jellett prism for polarimetric work. To him is due the elegant geometrical construction in which spirals are applied to express graphically the relative intensities of the light in diffraction images. His preference for geometrical demonstrations of theorems which might otherwise be hidden under a burden of analytical symbols was well known. He worked at acoustics in conjunction with M. Mercadier, and at elasticity, and in conjunction with M. Baille redetermined the constant of gravitation. He was occupied, too, with the problems of the synchronisation of two resonant systems capable of vibration under elastic forces, these memoirs being published in 1888 and 1889, the second of them including the application of his ideas to the synchronisation of clocks for the distribution of time. His plan was closely akin to that of Wheatstone, depending on the sending, at every second, of feeble induction currents generated by the movement of a magnet attached to the pendulum of a master clock. In 1884 he reported on the electric transmission of power by M. Marcel Deprez on the Chemin de Fer du Nord. He took part in the first electrical congress at Paris in 1881. In 1886 he became a member of the Bureau des Longitudes, and in 1900 of the International Commission on Weights and Measures. He was president of the Académie des Sciences; twice, at different periods, president of the Société de Physique; and by general consent was elected to preside also over the International Congress of Physics in 1900.

He was elected a foreign member of the Royal Society in 1884, and was also an honorary member of the Physical Society of London. In 1878 he received for his work on the velocity of light the Rumford Medal of the Royal Society. At least twice he gave Friday evening discourses at the Royal Institution; the last of these in 1895 on the physical phenomena of the high regions of the atmosphere.

In 1899 he delivered, with delightful eloquence and learned ease, the Rede lecture at Cambridge, on the wave-theory of light and its influence on modern physics. On this occasion, which was at the time of the jubilee celebration of Sir George Stokes, he received the honorary degree of Doctor of Science.

In Cornu, France has lost one of her most distinguished men of science, and one who, not only as investigator, but as teacher and wise counsellor, had won universal esteem and respect. A true follower of the great traditions of France in the pursuit of science, and a passionate follower of Arago, Biot, Fresnel and Fizeau, he was in his own person much more than this. He was the ideal of a well-equipped, well-balanced, intellectual leader in scientific thought. SILVANUS P. THOMPSON.

M. VIGNON'S RESEARCHES AND THE "HOLY SHROUD."

AT the meeting of the Paris Academy of Sciences on April 21, some remarkable photographs of brownish stains found on the "Holy Shroud" kept in the Treasure Chamber of Turin Cathedral, and traditionally said to be the winding-sheet of Christ, were exhibited in connection with a paper by Dr. P. Vignon, of which a translation from the current number of the *Comptes rendus* of the Academy is given below. Upon reproducing these stains by photography, Dr. Vignon found that he obtained a realistic picture of a human figure, and the suggestion is that the picture is actually a representation of the body of Christ, produced by radiographic action from the body, which, according to ancient texts, was wrapped in a shroud impregnated with a mixture of oil and aloes. We give Dr. Vignon's paper, which it will be noticed is confined to an account of principles relating to radio-activity.

ON THE FORMATION OF NEGATIVE IMAGES BY THE ACTION OF CERTAIN VAPOURS.

IT is known, from the work of M. Colson, published in the *Comptes rendus* of the Academy of Sciences in 1896, that freshly cleaned zinc emits vapours at the ordinary temperature which are capable of affecting photographic plates in the dark. The researches of Russell have also shown that the striations of a plate of zinc reproduce themselves on a photographic plate. But it is a long step from this to the realisation of an object in relief. I have succeeded in obtaining images either with medals powdered with zinc, or with bas-reliefs or objects fully embossed, in plaster, and rubbed with zinc powder. These images are negatives, not by the inversion of light and shade, since they are formed in the dark, but by the fact that the reliefs give more energetic impressions than the cavities. To interpret these it is necessary then to invert photographically; positive images are then obtained in which the scale of relief is scrupulously respected, which is far from being the case in normal photographs of the same objects illuminated from the front. Naturally, upon images made at a distance, the reproduction of the most minute details could not be expected, the precision of the detail obtained being less as the distance increased. The clearness of the image depends upon the rapidity with which the action diminishes when the space increases between the emissive surface and the receiving screen.

From a point of the active surface let a perpendicular be lowered on to the receiving plate; the foot of this perpendicular constitutes the centre of a circle which makes a more energetic impression in its central region than on its edges; the clearness of the image will thus be greater the smaller the surface of the circle acted upon, and this surface varies inversely as the rapidity with which the actions decrease when the distance increases. It is on this account that the images correspond very nearly to those which would be realised if the actions were produced only according to the orthogonal projections of the different points of the active surface.

It is a curious point that the images converted into positives frequently give rise to the impression of having been lit from above.

This will be the case when a plane, such as the forehead, is seen from the front and forms at the same time a strong relief, whilst a plane near it is rapidly shifting, such as, for example, the region which connects the superciliary arch to the eyeball. When this plane shifts it appears to sink into a deep shadow.

The truly specific character of these negative images which arise from action at a distance lies in the softness of the contours. The limit of the visible portion is the result for the eye of the receding of the surface. If this falling back takes place at a small distance from the receiving plane, the contour is still marked, though vaguely; but if this falling away is produced